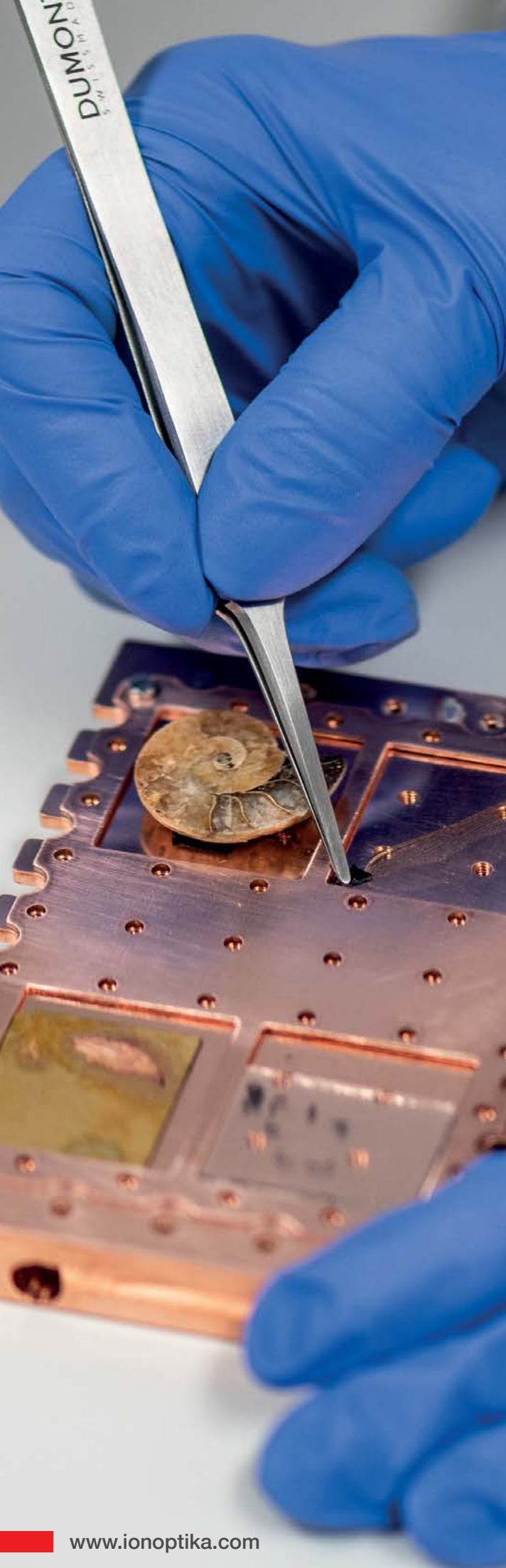


J Series III Cluster SIMS





J Series III

Cluster SIMS

Taking our original J105 Cluster SIMS to a new level, the J Series III offers 2D and 3D molecular and elemental imaging with high mass range, consistently high mass resolving power and unsurpassed sensitivity.

Developed specifically to use Gas Cluster Ion Beams (GCIB), the J Series III offers a vast range of experimental conditions; from high energy small Ar clusters, ideal for reducing preferential sputtering of hybrid materials, through to giant water clusters to lift intact proteins from biological samples.

With our unique 70 kV GCIB, and the ability to add C60 clusters, a plasma or liquid metal column, there is never a need to compromise!

The new J Series III offers:

- Consistently high mass resolving power across ALL sample types
- Up to three analysis guns including the unique 70 kV GCIB, Water Source, C60 or high performance plasma gun
- NEW long term Cryo system, significantly reducing LN2 consumption for continuous sample analysis
- NEW sample stage with larger analysis area
- Superb Z-resolution for 3D imaging and depth profiling
- Significantly increased transmission, offering unsurpassed sensitivity

“At the University of Surrey, we are delighted to be working in collaboration with Ionoptika to build the next generation of the Water Cluster SIMS around our MeV beamline, enabling multimodal and elemental imaging in fields as diverse as lipidomics and battery materials. Their team helped by providing access to their laboratory to provide proof of concept data and we have worked together with their engineers to design the system, which will be unique internationally.”

*Prof. Melanie Bailey
University of Surrey*

Harnessing the power of Gas Cluster Ion Beams

GCIB SIMS offers something different; with the J Series III, analysis of complex samples, such as biological tissues, hybrid multi-layered materials, polymers and samples with complex topography, all becomes feasible.

GCIB SIMS is not constrained by the same factors as monoatomic ion beams. Whilst excellent for homogenous, hard materials, monoatomic beams are damaging: resulting in inter-layer mixing, subsurface damage and fragmentation of high AMU species.

By using a GCIB analysis beam at 70 kV, the J Series III can use extremely large clusters, commonly up to 30,000 Ar or 60,000 H₂O. Total beam energy is distributed over the number of atoms in the cluster, giving a versatile e/n energy ranging from 2-2000 eV.

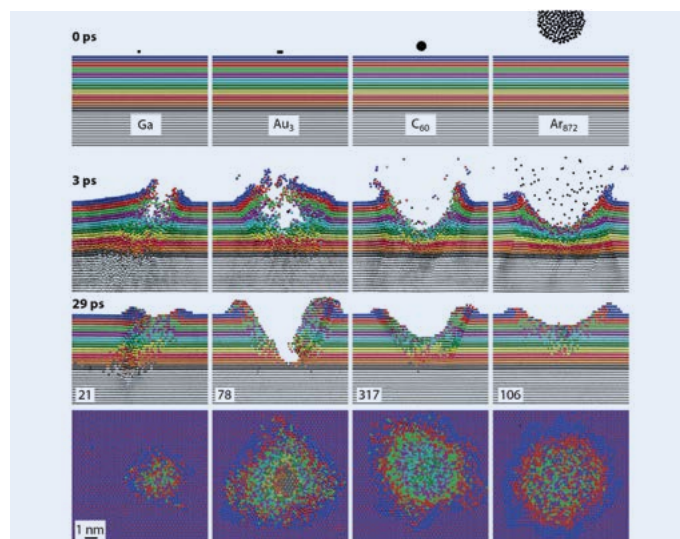
Larger clusters give rise to very low e/n, which:

- Significantly reduces fragmentation, lifting off high molecular weight species such as lipids, peptides and even small proteins.
- Reduces subsurface damage and inter-layer mixing.

All of which mean that 3D depth profiling and imaging is not just possible, it's simple. By using the GCIB as the primary beam for analysis, there is no requirement to clean or remove damaged layers, no etch-only cycle is needed and secondary ions are simultaneously sputtered

and analysed, giving rise to superior depth resolution and profiling.

The 70 kV GCIB also facilitates work with smaller gas clusters at very high total beam energy. With these, it's possible to fast etch through materials whilst maintaining excellent molecular sensitivity. The smaller clusters with a higher e/n are proving ideal for mixed and hybrid materials such as perovskites, OLEDs and glass.

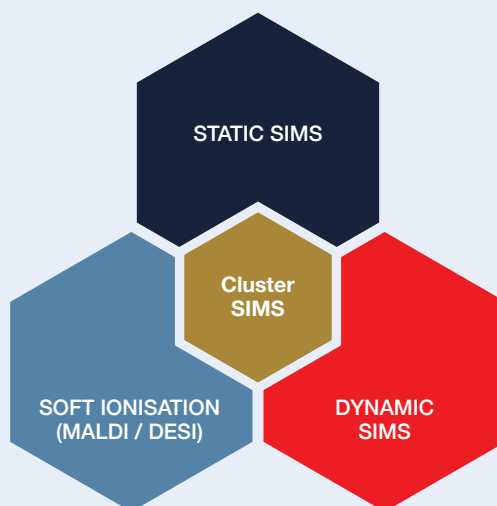


Winograd N, 2018, *Gas Cluster Ion Beams for Mass Spectrometry*, *Annu. Rev. Anal. Chem.* 2018. 11:5.1-5.20

Utilising cluster beams for both low-damage sputtering as well as high sensitivity molecular analysis, the J Series III is an analytical tool like no other.

SOFT IONISATION MS

- High molecular sensitivity
- Ideal for biological samples
- Very low fragmentation and surface damage
- High mass accuracy
- Tandem MS



STATIC SIMS

- High spatial resolution
- 3D molecular imaging
- High speed acquisition
- Compatible with a wide range of materials

DYNAMIC SIMS

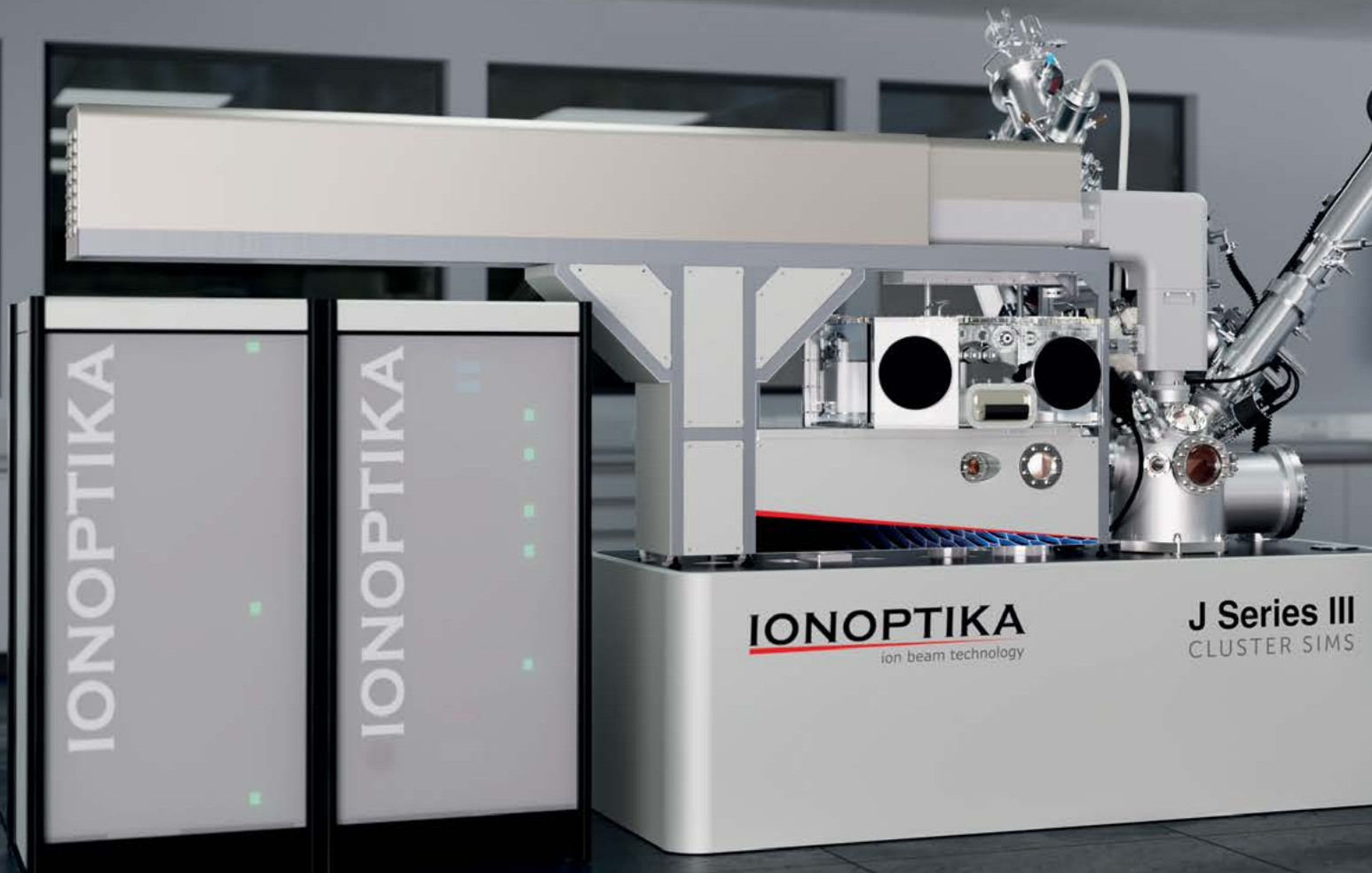
- High depth resolution
- Simultaneous sputter & analysis
- High monatomic sensitivity

Introducing the J Series III

Configured for your application

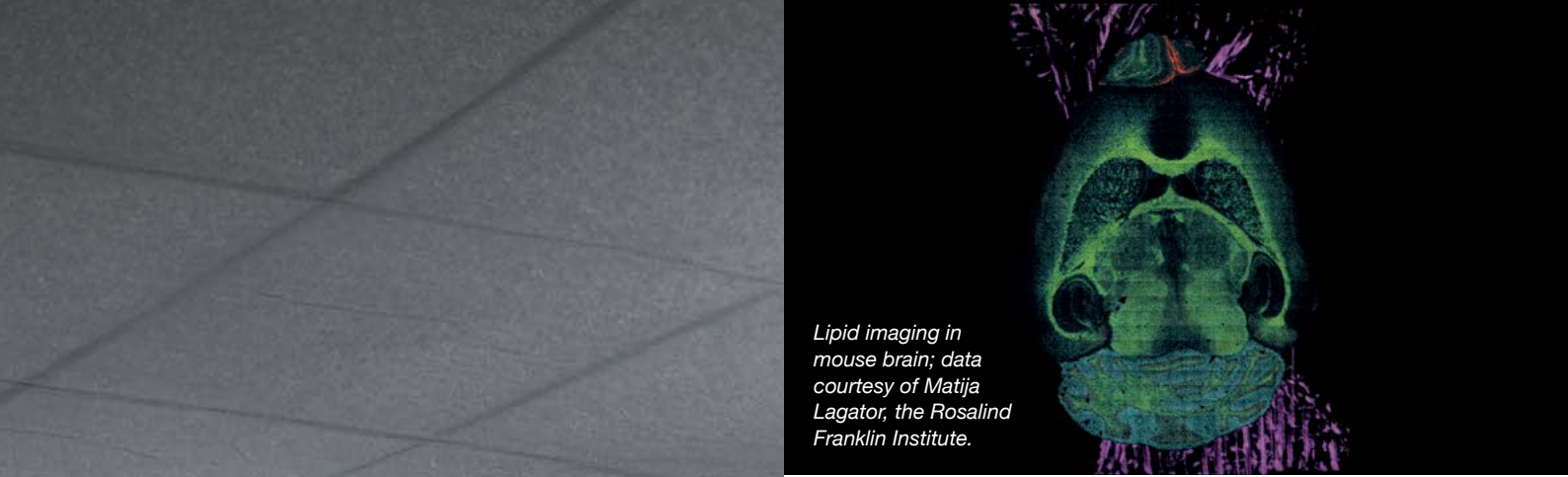
5-fold transmission
increase

High energy small
cluster option for fast non-
preferential sputtering



Cryo-compatible
glovebox for ice-free
sample transfer

Larger 100 x 70 mm
sample stub for multi
sample analysis



Ionoptika's patented water source for superior sensitivity (> 500-fold) of High AMU analytes

ECR plasma beam option

Long-lasting LN2 cryo-stage

Lipid imaging in mouse brain; data courtesy of Matija Lagator, the Rosalind Franklin Institute.

Choose up to 3 Primary Analysis Beams

- 70 kV Gas Cluster Ion Beam (GCIB): Image high mass species down to 1.5 μm , or fast analysis of hybrid samples in high energy/ low cluster mode.
- C60-40, combining utility with high performance, image mixed materials at 300 nm spatial resolution.
- New IOG-30 ECR Plasma gun (Xe, O₂, He) for fast sputtering with high brightness, down to 300 nm.
- IOG-25 LMIG with best spatial resolution at 100 nm for traditional SIMS of hard materials.

Configured as standard with:

Next Generation Cryo Sample Handling

- Minimal LN₂ consumption; 12L integral Dewar lasts up to 24 hours.
- New large sample holder, full area may be cooled to 100 x 70 mm.
- Compatible with commercial Auto-fill systems for multi-day analysis.

Unique Analyser

- The unique buncher-ToF analyser delivers high mass resolution and mass accuracy irrespective of ion beam type.
- High mass accuracy and mass resolution on rough samples and curved surfaces.

Tandem MS Mode

- For definitive peak assignments tandem MS mode is always included.

Specialist Analysis Software

- 2D and 3D Analysis built around imaging, with real-time spectral/image scanning.
- Identify patterns within the data, find related peaks, and make tentative assignments.
- Convenient export tools for common data formats such as HDF5 and imzML.

Applications

Biological Analysis

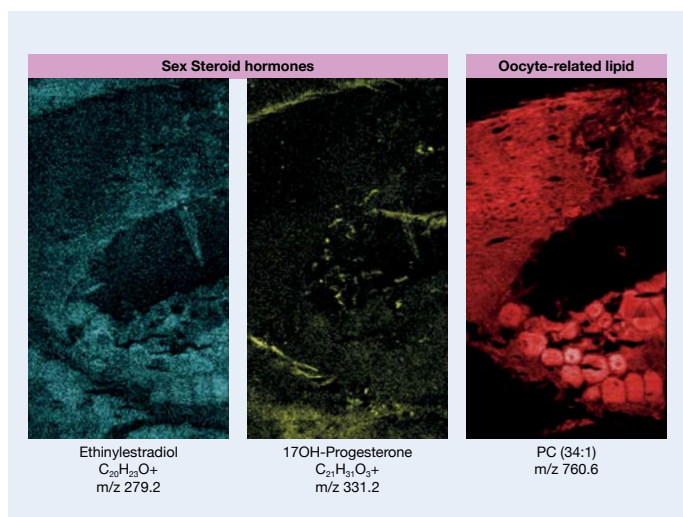
ToF SIMS was traditionally seldom used for biological samples due to the high energy, monoatomic ion beams which fragment high molecular weight species.

Yet alternative soft ionisation techniques are not ideal either; samples are often treated with a matrix, 3D imaging is challenging and analysis is usually at room temperature.

Using GCIB SIMS, the J Series III offers the best of both worlds: high spatial resolution, low fragmentation, low damage, 3D analysis, all in cryogenic conditions.

Imaging of Sex Steroids in Zebrafish

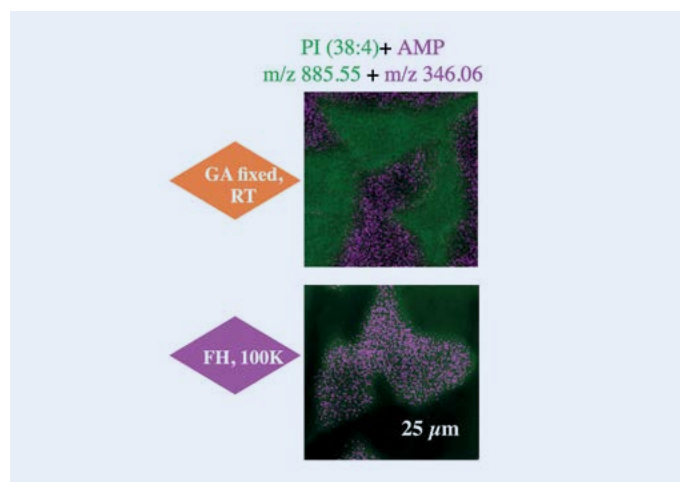
Steroid hormones are involved in physiological processes and mechanism of disease. However, analysis of steroids is difficult due to low polarity and poor ionisation efficiency. Furthermore, the signals often overlap with MALDI matrix background. Using GCIB SIMS with Water clusters at 70 kV on the J Series III, combined with a C60-40 ion beam, sex steroid hormones could clearly be imaged in a Zebrafish sample, even without Cryogenic analysis.



Cryogenic Analysis of Frozen Hydrated Cells

Cryogenic analysis is the ideal condition for biological tissue as it reveals the true spatial distribution of analytes in 2-D and 3-D; whereas freeze dried samples, analysed at room temperatures (RT) tend to offer misleading data due to the migration of volatile species. Unfortunately the complexity and cost usually makes Cryo analysis prohibitive.

By simplifying the Cryo analysis workflow and reducing the cost with the new long-term Cryo stage, the new J Series III allows for daily routine analysis at cryogenic conditions.



Data courtesy of Hua Tian, University of Pittsburgh

HeLa cells were analysed with a GCIB at 70 kV at both RT (Glutaraldehyde fixed) and under cryogenic condition at 100 K.

During RT analysis, we show that the small volatile compound, ATP, has migrated out of the HeLa cells. In the sample run at 100 K, the ATP is shown colocalized with the HeLa cells.

Materials Analysis

The J Series III is ideal for materials analysis applications. The unique design means that it can be used with any ion beam, without sacrificing mass resolving power or mass accuracy.

Ionoptika's 40 kV C60 ion beam system demonstrates reduces preferential sputtering on hybrid materials, and the IOG 30 ECR plasma source is excellent when fast sputtering on hard materials is required.

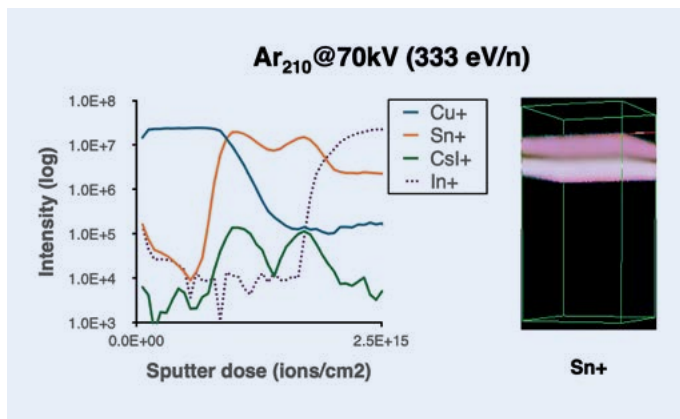
High energy smaller dense clusters show an even greater reduction in preferential sputtering with the 70 kV GCIB, ideal for analysis of hybrid materials.

Perovskite samples

Use of GCIB in high energy, small clusters mode is an emerging field, inspiring novel applications for ToF SIMS.

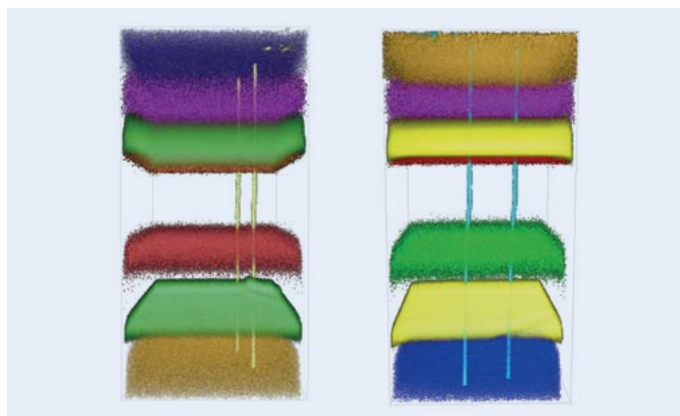
Smaller clusters, with a high total beam energy, offer fast non-preferential sputtering, providing high resolution 3D imaging and depth profiling on multi layered stacked mixed and hybrid materials.

Perovskite samples, for example, are generally presented with the capping layer removed as profiling through this would require an energetic beam which would cause much damage to the underlying layers. Using 70 kV GCIB in small cluster mode, the J Series III profiles easily through perovskites with the capping layer intact, enabling 3D imaging and depth profiling.



Glass Samples

The J Series III was used to provide a 3-D image and depth profile of a multi (7) layer glass sample. This highly charging sample with layers of around 100 nm would normally provide quite a challenge for any ToF SIMS instrument. Using the 40 kV C60 ion beam, we clearly image the individual layers within the glass sample and notice the potassium channels that have opened up within.



“As a company, Ionoptika do not shy away from a challenge and their pioneering spirit has led to important developments in SIMS technology. Our J105 instrument allows us to tackle challenges in new ways, delivering high quality data from a wide range of inorganic to clinical samples.”

**Prof. John Fletcher
University of Gothenburg**

Ion Beam Options

ION BEAM	SPECIES	ENERGY RANGE	MIN. SPOT SIZE	APPLICATIONS
GCIB 70 (SM)	$\text{Ar}_n, (\text{CO}_2)_n, (\text{H}_2\text{O})_n$	20-70 kV	1.5 μm	Organic/biological materials, polymers, depth profiling, heterostructures
IOG C60-40	$\text{C}_{60}^+, \text{C}_{60}^{++}, \text{C}_{60}^{+++}$	10-40 kV	300 nm	Organic/biological materials, inorganics, metals
IOG-30 ECR	He, N_2 , O_2 , Ar, Xe	5-30 kV	300 nm	Semiconductors, metals, inorganic materials
IOG-25 LMIG	$\text{Au}^+, \text{Au}^{++}, \text{Au}_2^+, \text{Au}_3^+$	5-25 kV	150 nm	Semiconductors, metals, inorganic materials
FLIG 5	O_2, Cs	0.2-5 kV	15 μm	Semiconductors, depth profiling

Key Features

- Achieve the broadest range of analysis conditions with the 70 kV GCIB; **from perovskites to proteins** with a single ion column!
- High-resolution 2D & 3D imaging SIMS with unprecedented sensitivity.
- Consistently high mass resolving power on ALL sample types from lipids to metals.
- High performance analysis of charged, rough and multi-layered samples.
- Twice the mass resolving power of the J105.
- 24/7 Analysis at 100 K or room temperature.
- Analyse samples in their natural state; rough, curved, uncoated; without loss of mass accuracy or resolution.
- 5-fold increase in transmission allows imaging of low abundance analytes.

Let us show you what the J Series III SIMS can do

At Ionoptika, we firmly believe that our results speak for themselves. We are always pleased to discuss specific applications with prospective customers and collaborators, and to demonstrate our instruments in person.

“With the innovative J105, Ionoptika set the SIMS community on a new path towards molecular depth profiling and 3D imaging on practical timescales”

Prof. Nick Lockyer

University of Manchester

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